

METHOD AND APPARATUS RENDERING CAUSTICS

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims the benefit under 35 USC §119(a) of Korean Patent Application No. 10-2015-0145737 filed on Oct. 20, 2015, in the Korean Intellectual Property Office, the entire disclosure of which is incorporated herein by reference for all purposes.

BACKGROUND

[0002] 1. Field

[0003] The following description relates to a method and apparatus for rendering caustics.

[0004] 2. Description of Related Art

[0005] Caustics are various light patterns shown when light is reflected or refracted by a transparent or semitransparent object, for example, water, glasses or plastics, and hits a neighboring object. Modeling of caustics require a large amount of calculation and time to calculate positions of collisions of a large number of rays emitted from a light source and refracted or reflected by a neighboring object. Accordingly, it has, heretofore been difficult to perform modeling of caustics in real time.

SUMMARY

[0006] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0007] According to a general aspect, a method of displaying caustics includes determining intersection positions at which rays emitted from a light source pass through particles of a first object and meet a second object; applying caustic textures to the intersection positions; and rendering the first object using a caustic map based on a result of the applying caustic textures to the intersection positions.

[0008] Determining of the intersection positions may include tracing a path of the rays and calculating the intersection positions for each of the particles.

[0009] The method may further include receiving at least one of information about a position of the light source, a depth map pre-rendered from the position of the light source, positions of the particles, and a surface normal vector of the first object, wherein the determining of the intersection positions comprises calculating the intersection positions for each of the particles based on the received information.

[0010] The determining of the intersection positions may include calculating intersection positions for particles directly visible from the light source among the particles.

[0011] The determining of the intersection positions for the particles directly visible from the light source may include determining the particles directly visible from the light source among the particles.

[0012] The determining of the particles directly visible from the light source may include determining the particles directly visible from the light source among the particles, based on first depth information of a depth map pre-rendered from a position of the light source.

[0013] The determining of the particles directly visible from the light source may include determining whether the rays directly reach the particles based on a result of a comparison between the first depth information and second depth information of the particles, the second depth information acquired by converting positions of the particles viewed from a viewpoint to a space of a virtual camera in the position of the light source.

[0014] The applying of the caustic textures to the intersection positions may include marking vertices corresponding to the intersection positions; and applying the caustic textures to the vertices.

[0015] The applying of the caustic textures to the vertices may include selecting the caustic textures based on at least one of a fluid surface curvature of each of the particles corresponding to the vertices or a distance between the vertices and the particles; and placing the selected caustic textures on the caustic map to correspond to the vertices.

[0016] The placing of the selected caustic textures on the caustic map may include placing virtual particles on the caustic map based on a complexity of particles corresponding to the selected caustic textures; generating, based on the virtual particles, caustic lines used to connect the selected caustic textures to each other; and connecting the selected caustic textures to each other by the caustic lines.

[0017] The generating of the caustic lines may include generating the caustic lines at equal distances from particles corresponding to an outline of each of the selected caustic textures and neighboring virtual particles.

[0018] The applying of the caustic textures to the intersection positions may include controlling an application intensity of the caustic textures based on an angle between a surface normal vector of the first object and an incident direction of the rays.

[0019] The controlling of the application intensity may include increasing the application intensity in response to the surface normal vector being parallel to the incident direction; and decreasing the application intensity in response to the surface normal vector being perpendicular to the incident direction.

[0020] The applying of the caustic textures to the intersection positions may include adjusting an application size of the caustic textures based on a distance between positions of surface particles of a surface of the first object and intersection positions corresponding to the surface particles.

[0021] The adjusting of the application size may include adjusting the application size so that the caustic textures appear larger in response to the distance being greater than a preset reference value; and adjusting the application size so that the caustic textures appear smaller in response to the distance being less than the reference value.

[0022] The rendering of the first object may include combining the caustic map with at least one of a specular map and a diffuse map.

[0023] The caustic textures may be stored in advance in correspondence to the particles, or may be generated by connecting and interpolating the stored caustic textures based on light and an external force exerted on the first object.

[0024] The first object may have transparent or semitransparent properties allowing the rays to be refracted and reflected by passing through the first object.